

# NATURAL HISTORY OBSERVATIONS OF THE NATIVE CARRION BEETLE, *PTOMAPHILA LACRYMOSA* SCHREIBERS (COLEOPTERA : SILPHIDAE)

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The natural history of *P. lacrymosa* Schreibers was studied in southern Victoria. The species was active year-round, with adults attending putrefying vertebrate carrion. Larvae were present mainly during dry decay. Adults fed on carrion and dipteran maggots, while larvae consumed skin and flesh from carcasses. Lifecycle duration varied seasonally and there was little reproduction during colder months.

*Key words:* Silphidae, *Ptomaphila lacrymosa*, carrion.

MOST Silphidae are carrion beetles, although predaceous and phytophagous species also exist (Cooter 1991). The family has two subfamilies: the Silphinae and the Nicrophorinae (Schilthuizen & Vallenduik 1998). The latter includes the well-known burying beetles of the Northern Hemisphere (*Nicrophorus* spp.), which bury small mammal carcasses and provide parental care for offspring (Peck 1982).

The family Silphidae is poorly represented on southern continents, possibly because equatorial climates present a barrier to its southward dispersal. In the wet tropics, competition from abundant rival necrophages, such as blowfly larvae, may remove carrion too quickly for most species to complete their lifecycle, and the deserts, through desiccation, render carrion unsuitable for breeding (Matthews 1982).

Three silphid species occur in Australia and all are carrion breeders in the Silphinae. Although Australian silphids are common and conspicuous, there have been no formal studies of their biology. *Diamesus osculans* (Vigor), a striking black and red beetle with truncate elytra, occurs through India, Indonesia, Papua New Guinea and north-eastern Australia. The remaining two species are confined to Australia. *Ptomaphila perlata* (Kraatz) occurs along the east coast from East Gippsland to Cape York, while *P. lacrymosa* inhabits the south-east and south-west of the continent (Lawrence & Britton 1991).

Like most carrion insects, silphids attend carcasses at specific stages in the decay process, but there is little information about their place in carrion succession. There are at least four sequential stages in carcass decay: 'fresh', 'putrefaction', 'dry decay' and 'remains', although the exact stage

numbers and names may vary between authors (see Smith 1986). In Western Australia, Bornemissza (1957) found *P. lacrymosa* adults on putrefying guinea pig carcasses and larvae during 'butyric fermentation' (roughly equivalent to stage designated 'dry decay' here). However, whether this applies in Victoria and how these results vary seasonally, is unknown. I investigated aspects of ecology, life history and behaviour of *P. lacrymosa* as part of a study on the carrion invertebrates of Victoria.

## METHODS

### *Observations from natural carrion*

This section forms part of a two-year study on seasonal insect succession in vertebrate carrion that is ongoing at Coranderrk Bushland (Healesville, Victoria). Work was conducted in a eucalypt forest with a wiregrass understorey at the border of a swamp. Every two months for the past year (since December 1998), five still-born piglet carcasses were placed at least 30 m apart in scavenger-proof Weldmesh™ cages (mesh size 25 mm) and left to decay. In summer, carcasses were visited daily for a week after placement, then every second day for the following week, and thereafter as often as merited, until they were skeletonised. In autumn, winter and spring, I visited carcasses roughly half as frequently as in summer.

At each visit, appearance and odour of carcasses were described, enabling the duration and characteristics of decay stages to be determined. Also, insects on carcasses were sampled and censused and counts of *P. lacrymosa* were made. Feeding behaviour, location on the carcass and general behaviour of beetles were also noted.

### Observations of captive beetles

Some observations of captive *P. lacrymosa* were made between November 1998 and March 1999. Eighteen adult males and 18 adult females were taken from Kangaroo Ground (Victoria) over three weeks in November 1998. They were captured at the edge of a eucalypt reserve using bait traps that were cleared weekly. Traps were upturned 120 mm diameter flower pots sunk into the ground and baited with 200 g of beef.

Beetles were kept at room temperature (uncontrolled) in gauze-covered round plastic containers (120 mm high, 115 mm diameter). Containers were filled with damp soil (80 mm deep) and were misted daily with water. Six beetles (three males, three females) were placed in each container and were fed raw beef, which was changed every two days. After death, the body length of each beetle was measured with digital calipers.

## RESULTS AND DISCUSSION

### Description of *P. lacrymosa*

*P. lacrymosa* is a large tan beetle with central areas of black on the pronotum and elytra. The elytra, which cover the abdomen, are patterned with tubercles and longitudinal ridges, and the apices are squared in the male and angled in the female. Antennae are 11 segmented with an orange club. Larvae, which are black with a flattened appearance, are around 3 mm long at hatching. Prepupae are 20–23 mm long.

Adult males were significantly longer than females ( $t = 2.8$ ,  $df = 17$ ,  $p < 0.01$ ). Male body length range was 17.9–30.5 mm (mean = 25.5,  $SE = 0.7$ ,  $N = 18$ ), and female body length range was 17.9–24.7 mm (mean = 23.2 mm,  $SE = 0.37$ ,  $N = 18$ ).

### Stages of carrion decomposition

I divided piglet decomposition into four major stages:

1. fresh (roughly three days in summer and 12 days in winter): piglets exuded no odour and no body fluids leaked;
2. putrefaction (roughly 11 days in summer and 70 days in winter):
  - (i) initial putrefaction—fluid leakage from orifices began, odour and discoloration developed
  - (ii) bloat—the carcass often swelled considerably due to internal gas production

- (iii) advanced putrefaction—odour was strongest, skin turned dark, flesh liquefied and pooled under the carcass;
3. dry decay (roughly 15 days in summer and 29 days in winter): most of the body contents had dissipated and only skin, bones and connective tissue remained; and
4. remains: only bones and hair remained.

### Seasonal occurrence and place in succession of *P. lacrymosa*

The species was active all year, although activity and breeding were greatly reduced between April and July (Table 1). In these months, *P. lacrymosa* adults were also more commonly found dead at carcasses. Adult abundance peaked in the summer months, although the highest larval numbers were recorded in late August and September (Table 1). This may be due to ideal moist, warm weather conditions.

The relatively low numbers of larvae seen on carcasses placed in October (Table 1) could possibly be attributed to the short duration of the adults' stay, combined with the small adult populations recorded on carcasses in this month. Heavy rain near the end of advanced putrefaction washed most of the flesh from the October carcasses and this speeded their entry into dry decay, thus making them prematurely unsuitable for oviposition by *P. lacrymosa*.

*P. lacrymosa* adults occurred on carcasses throughout putrefaction. In the warmer months they arrived during initial putrefaction, although in cold months they arrived later during bloat. Possibly, slower metabolic rate in cold weather increases the time taken for beetles to locate suitable carrion. Alternatively, low temperatures may reduce gas evolution and dispersal from carcasses, therefore making them harder to locate. Adults always left carcasses by the end of putrefaction, before they entered dry decay (Table 1).

Larvae appeared at the end of advanced putrefaction and fed through dry decay. In summer and spring they left carcasses by the end of dry decay. In autumn and winter, however, most larvae remained on carcasses well into the remains stage (Table 1), after edible carrion had disappeared. These fully grown larvae sat motionless among the bones or curled in shallow depressions in the earth and some remained until they died. It is probable that southern Victorian autumn and winter temperatures are too low for normal reproduction by *P. lacrymosa*, meaning that few larvae are produced and many of these do not reach maturity.

| Carcass placements<br>(days taken to decay) | Stage(s) <i>P. lacrymosa</i><br>present | Approximate<br>D.A.P. present | Approximate<br>abundance range | Carcasses present on<br>(N = 5) |
|---|---|-------------------------------|--------------------------------|---------------------------------|
| Mid December (20–30)                        |   |                               |                                |                                 |
| Adults                                      | Putr.                                   | 2–7                           | 1–30                           | 5                               |
| Larvae                                      | Adv. putr.—dry                          | 6–20                          | 1–30                           | 5                               |
| Mid February (26–30)                        |   |                               |                                |                                 |
| Adults                                      | Putr.                                   | 3–13                          | 1–50                           | 5                               |
| Larvae                                      | Adv. putr.—dry                          | 9–30                          | 10–30                          | 5                               |
| Mid April (77–84)                           |   |                               |                                |                                 |
| Adults                                      | Bl.—adv. putr.                          | 19–48                         | 1–9                            | 4                               |
| Larvae                                      | Adv. putr.—rem.                         | 48–111                        | 1–4                            | 3                               |
| Mid June (100–109)                          |   |                               |                                |                                 |
| Adults                                      | Bl.—adv. putr.                          | 23–85                         | 1–2                            | 4                               |
| Larvae                                      | Adv. putr.—rem.                         | 55–105                        | 2–9                            | 4                               |
| Late August (39–48)                         |   |                               |                                |                                 |
| Adults                                      | Putr.                                   | 7–29                          | 1–5                            |                                 |
| Larvae                                      | Adv. putr.—dry                          | 16–48                         | 10–60                          | 5                               |
| Late October (52–58)                        |   |                               |                                |                                 |
| Adults                                      | Putr.                                   | 6–14                          | 1–3                            | 5                               |
| Larvae                                      | Adv. putr.—dry                          | 14–58                         | 1–13                           | 4                               |

Table 1. Seasonal decay time (days taken to enter remains stage) of piglet carcasses, and seasonal activity of *P. lacrymosa* adults and larvae on these carcasses placed at Coranderk, Healesville in 1998–99. D.A.P. = 'Days After Placement' of carcass, where the day of placement is designated '0'. Bl. = bloat; putr. = putrefaction; adv. putr. = advanced putrefaction; dry = dry decay; rem. = remains.

#### Lifecycle of *P. lacrymosa*

When provided with beef and damp soil, one group of captive females oviposited within a day, although the remaining two groups did not. Forty-seven spherical eggs were laid between 20–70 mm deep in the soil. Only 14 larvae appeared, all after four days, and they grew rapidly on beef. However, all died of unknown causes within three weeks.

On natural carrion, new larvae appeared over a period of one to two weeks. This indicates that, in spring and summer, eggs may be laid through most of putrefaction, although in autumn and winter, oviposition was so reduced as to suggest placement by only one or two females per carcass, possibly only on unusually warm days. Larval maturation times varied seasonally: the larval stage lasted between two and three weeks in summer, around one month in spring, and around two months in autumn and winter (Table 1). Mature larvae left carcasses to pupate.

One mature larva taken from the field in March pupated in captivity; however, this individual remained exposed on the soil surface. Due to predation and desiccation risk, this is unlikely to be normal behaviour, and like foreign silphid species (see Payne 1965), *P. lacrymosa* probably pupates in the soil. The pupal period of the captive beetle lasted 13 days and normal adult coloration

developed fully after three days. The callow adult male was not observed to feed for seven days. Adult lifespan remains unknown, however, and the longest any adult survived in captivity was two months.

#### Diet and behaviour on carrion

Adult *P. lacrymosa* eat dipteran maggots of all ages, dead blowflies and carrion. They search deep inside carcasses to locate maggot masses and were frequently observed emerging from orifices covered in putrid flesh, and with a live maggot in their mandibles. They generally consume their prey under the carcass, where most adults aggregate, but they sometimes feed on top.

Larvae feed mainly on dried flesh and skin. However, cannibalism by a group of four larvae (around 20 mm) was once observed. Larval feeding frequently occurred in tight groups of up to 20 and usually began at the head and feet of the carcass. In this study, *P. lacrymosa* larvae were the main agents of skin removal during dry decay, and in spring and summer they rapidly skeletonised carcasses. However, *Ptonaphila* require moisture to breed (Matthews 1982), and in drier areas silphid larvae are likely to be outnumbered or replaced by the larvae of Dermestidae, Cleridae (Coleoptera) and Tineidae (Lepidoptera).

*P. lacrymosa* are sensitive to vibrations and seek refuge at the slightest disturbance to the carcass. Adults and larvae hide within or under the carcass and adults may also escape into the leaf litter. Adults and larvae excrete foul-smelling liquid faeces if handled.

Larvae of all ages frequently wandered from carcasses and were found up to 2 m away, usually motionless. Larvae on carcasses with little skin remaining wandered furthest and at all times of the day. This may enable location of body parts that have been moved by scavengers, which can provide the larva with further food. The frequency of wandering was also high in the morning during cold weather. Often, almost the entire larval population of a carcass left, although the distance moved was usually less than 200 mm. The reason for this behaviour is unknown, although since wandering larvae often aggregate in patches of sunlight, morning wandering may be an attempt to find areas of warmth to speed growth. In further support of this, larvae usually moved back onto the carcass to feed as it became exposed to sunlight.

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